ity who have no relish for becoming charity patients can obtain the medical attention they require at prices that are not prohibitive. There is a growing sentiment, both in the medical profession and out of it, in favor of working out a solution of this problem, and we are perhaps justified in looking forward to a more effective and satisfactory regime in the years to come.

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THE RELATION OF THE TECHNICAL SCHOOL TO INDUSTRIAL RESEARCH[1]

Research is earnest, purposeful, persistent, intelligently directed effort to gain new knowledge of a selected subject. The spirit of research is devotion to truth and insistent longing for better understanding.

Industrial research is research done for industry. It may be:

1. In fundamental sciences, or
2. In applications of sciences.

It is difficult to set limits for the second class, distinguishing research from experimental development of processes, methods or equipment.

In the main, the environment of an industrial establishment is not congenial to fundamental research in the sciences. Furthermore, the connection between fundamental research and the business of a given establishment commonly is so attenuated that it is difficult for boards of directors to see justification for expenditure of stockholders' money for such research. Fundamental research, having less immediate connection with commercial profits, there is much less incentive for its control or for secrecy with respect to its results, in the interest of one establishment or group. Hence, fundamental research is especially suitable for those technical schools which can afford research departments. Then, too, such research lies close to the recorded knowledge and the theory with which the student has been familiarizing himself in his courses of study. It is a rare undergraduate, however, who will be competent for more than an assistant's part in research.

Industrial research in technology, or applied science, demands practical experience in the industry as a preparation for successful work. Indeed, it can not be done without knowledge of the particular industry. It often requires equipment or facilities of a kind or magnitude which can not be provided in technical schools. Only for limited problems, or under special arrangements, therefore, will this class of research properly be undertaken within a school. Students and faculty members may, however, participate in such research within an industrial plant under suitable conditions. Such direct connections with industry are stimulating to both teachers and students, and help to create a spirit of mutual appreciation between industries and schools.

The fields of research in which industry is concerned must not be too narrowly conceived by the schools. These fields are not limited to physics and chemistry, but include all the mathematical, physical and biological sciences, economics, and, not least, though mentioned last, those branches of inquiry which relate to men and women in industry, comprised in the term "personnel." To advance such studies, there has been established by the joint efforts of National Research Council and Engineering Foundation, the Personnel Research Federation. It has for its purpose the correlation of research activities pertaining to personnel in industry, commerce, education and government wherever researches are conducted in the spirit and with the methods of science. Its membership includes selected national organizations representing scientists, engineers, educators and the American Federation of Labor. The membership is now being widened to include other organizations of kindred interest. It has been learned that there are approximately 250 organizations in the United States giving

[1] A paper presented to the Conference on Engineering and Industry in connection with the inauguration of President John Martin Thomas, Pennsylvania State College, October 13, 1921.

some attention to personnel research along various lines.

It is surprising to one who has not had a share in the direction of a great engineering enterprise to learn how broad and various is the knowledge demanded in the creation of a Catskill aqueduct, a Panama Canal, a Pennsylvania Railroad system, a Niagara power development, an East River bridge, a Hudson tunnel, a manufacturing plant of modern magnitude, or a great mine.

A primary duty of technical schools is to discover young men with genuine research spirit and capacity. For this purpose, psychologists may be able to devise tests equivalent to those developed by Professor Seashore for detecting innate musical talent.

A second obligation is to train these naturally endowed men thoroughly for research careers. The technical schools should distinguish the individual who by nature is a lone worker from the team worker, and train each suitably, but should indicate to all the value of cooperation.

A third obligation is to instill the research spirit into all technical students. The technical school should foster the habit of inquiry—not mere inquisitiveness, but the purposeful search for truth, the alertness that asks "Why" of every phenomenon, the keenness of observation that does not pass indications which the dull-minded would call trivial.

The technical schools should not only discover and educate the rare man with research capacity, but should also train men who can be foremen and technical directors of industrial plants, capable of appreciating research and of working sympathetically with research specialists.

There are numerous ways in which each technical school can give research service to the industries within the region contributory to the school. Each school may well specialize to some degree according to the needs of its community. Through some central organization, the schools of the country should, however, keep one another informed of contemplated projects and specialities chosen so as to get the most beneficial distribution of such specialization without undesirable duplication. Choice of specialities should vary from time to time with progress in scientific research and change in the needs of industry.

In helpful relationship to research in the industries, the technical schools should teach their students:

1. How to assemble, arrange and analyze conditions so as to state a problem;
2. That it is wise before plunging into a program of work to learn what the literature contains (a large proportion of supposedly original problems can be answered from records of work done, to be found in our libraries);
3. The economy of spending sufficient time to understand the problem and to compare several methods before launching upon any one method of attack;
4. How to select and use the simplest apparatus and method for a given research which will accomplish the purpose, but to make sure of their adequacy; also how to analyze the apparatus and instruments, as well as the method, to detect unsuspected sources of error;
5. To limit the undertaking according to the resources and time available;
6. That there are elements of research in every technical task, which require the ever watchfulness for new light, new aspects, new applications;
7. How to extract research information out of both the ordinary experiences and the unusual happenings in the plant;
8. How to secure the intelligent and enthusiastic cooperation of foremen and operatives in observing closely and reporting accurately in the course of their daily work incidents which may be helpful to a research in progress;
9. The value of research, even when its results seem remote from the present purpose of industry;
10. How to express scientific knowledge interestingly—fascinatingly, but still correctly—in language readily understand-

able, by directors, managers and other executives;

11. To cultivate some of the journalist's sense of the story in research work;
12. And throughout their courses, the technical schools should teach the fundamentals of the sciences so thoroughly that the graduate can think for himself and will not be at his wits' ends when a problem in his future work does not fall within the limits of the formulae specifically taught or the books available.

Research has no end. It must be kept up perpetually. The technical schools must be soundly convinced of this fact and through their graduates, must impart it to the industries, lest unprogressiveness rob the community of the benefit of new knowledge.

Technical schools should convey, also, to their research students some conception of the exigencies and financial necessities of business and instill into them appreciation of the importance and difficulty of the financial problems and patience for the apparent slowness with which industry and business sometimes put into effect the results of research. The scientific man seeks the confidence and appreciation of the business man and he should reciprocate.

The greatest service of all which the technical schools and the universities can do for industry and for the community is to infuse into all workers from unskilled labor to highest executives that appreciation for truth and that conviction of the futility of deceit which are forced upon the scientist and the technologist, by the very nature of their work. Neither science, nor technology, nor industry, nor business, can permanently flourish on deception or on a narrow and selfish conception of profit.

Alfred D. Flinn

THE PRESENT STATUS OF UNIVERSITY MEN IN RUSSIA

For a long time after coming into power the soviet government of Russia maintained a seriously discouraging attitude toward the university faculties and the Russian professional and scientific men in general—the "intelligentsia." But this attitude is now modified and still modifying. Along with the other changes in attitude and action characteristic of the recent months of soviet government, changes very marked in relation to business and general economic matters, changes have also been made in the way of ameliorating the situation of the university men.

The salaries, paid in paper roubles of constantly depreciating value—they are now worth about 75,000 to the dollar!—were very low, becoming, indeed, as the value of the rouble lowered, simply derisory. But more important, in Russia, than any salary paid in money—unless it get into millions of roubles a month—is the "paiok" (I spell it as pronounced), or food ration, that is the essential part of the reward for services to the government. As is familiarly known, the soviet government established several grades of ration according to various categories into which the people could be roughly divided. The working man got the largest or best ration; the university man nearly the lowest.

In my recent (September-October) visit to Russia as special representative of the American Relief Administration, I learned something at first hand of the changing situation of the university and professional men of the country. I was not in Petrograd, but saw a number of faculty men in the universities of Moscow, Kazan, and Samara. Samara is one of the several new universities (?) set up by the soviet government. It has four faculties, medicine, law, agriculture and "workers." The "workers' faculty" offers elementary classes for the sons and daughters of working men and peasants to fit them for matriculation in the professional departments of the university. The president of Samara University, himself a specialist, as he said, in the Italian Renaissance, intimated that his institution was meeting many difficulties, the principal one being that of finance—a difficulty not unknown outside of soviet Russia. However, while we talked, students were